PAPER

IN

CHEMISTRY.

THE

FOLLOWING

ESSAY

ON

PORTABLE FURNACES,

IS RESPECTFULLY PRESENTED

TO THE

SOCIETY

BY THEIR

SECRETARY.

AN ESSAY

ON

PORTABLE FURNACES.

THE well-known advantages that have accrued to experimental philoſophy, and to the Arts, particularly thoſe that depend on chemical proceſſes, from the uſe of portable Furnaces, render it unneceſſary to ſay any thing in commendation of the invention; but as by them gentlemen of rank and fortune, (from whom experiments are chiefly to be expected) are enabled further to proſecute thoſe ſtudies which have already been

been the origin of many of the benefits the publick reap from the preſent improved ſtate of our manufactures, it may not be unprofitable to give a ſhort account of the invention, deſcribe the ſeveral kinds moſt in uſe, and, as all hitherto contrived have laboured under ſome objections, to ſhew a cheap and eaſy method, confirmed by conſiderable experience, by which thoſe defects are remedied, and the uſe of ſuch furnaces rendered more agreeable and commodious.

It is not in this paper intended to deſcribe the ſeveral forms, which ſometimes the judgment, and ſometimes the caprice of the maker, have adopted; but to ſhew that the materials of which they have been conſtructed, though fit for the purpoſe intended, have nevertheleſs been hardly ever properly applied; and then lay before the reader, the method alluded to above, of obviating the objections hitherto made to them.

To

To the celebrated JOHN JOACHIM BECHER, we owe the invention of Portable Furnaces, contrived for performing the different kinds of chemical proceſſes, of which he has given us a full hiſtory and explanation, with many plates, in his work entitled, *Scyphus Becherianus*. In the Introduction to that work, the author ſays, That having obſerved ſome workmen melt iron in a ſmall furnace, it occured to him that ſomething might be contrived by which the ſeveral chemical proceſſes might be conveniently perfomed; and that having completed his ideas on this head, ſome of the firſt furnaces made, were purchaſed by Dr. Dickenſon, phyſician to the King, Prince Rupert, and the Honourable Mr. Boyle.

He directs the furnace to be made of plate iron, having rivets, faſtened at different places, with heads projecting ſufficiently withinſide the furnace. As the

furnace was to be (to the thickneſs of one inch and half) lined with a lute compoſed of clay and ſand; theſe rivets were intended to prevent its cracking, and falling from the ſides.

The uſe of ſuch a contrivance as this, appeared ſo commodious to the late Dr. Shaw, and Mr. Hawkſbee, (to whom the preſent taſte for chemical experiments, is in a great degree owing) that, in the year 1731, they publiſhed, with conſiderable additions to Becher's tract, a ſmall volume entitled, "An Eſſay for introducing a portable Laboratory," for which, as they ingenuouſly acknowledge, they were almoſt wholly indebted to Becher. The furnace deſcribed by Dr. Shaw and Mr. Hawkſbee, differs little from that of Becher, and, like it, is intended to be lined with a lute, which is to be ſecured to the iron plate by means of rivets.

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This has been hitherto almoſt the univerſal practice in forming portable furnaces for chemical experiments; and it is but juſtice to ſay, that to theſe authors are to be aſcribed the invention and introduction of furnaces on this conſtruction, however the ſhapes may have been varied ſince their time.

Another kind of portable furnaces, if they may be ſaid to deſerve the title, were contrived by Johanne Franciſco Vigani, and the deſcription of them, with figures, publiſhed by him in a ſmall treatiſe entitled, *Medulla Chymiæ*, printed in London, 1683, and dedicated to three Engliſh Noblemen.

As theſe furnaces conſiſted ſolely in having a number of bricks ſo fitted together and marked, that they might eaſily be taken aſunder, when an operation was finiſhed, and commodiouſly ſet

aſide until they ſhould be again wanted: the frequent miſlaying, or loſs of the looſe bricks, ſoon brought this kind of furnace into diſuſe, in experimental laboratories; though it muſt be owned, it has in many caſes ſome advantages, and is often uſed, to this day, by plumbers and other workmen.

About the year 1750, the late Dr. Lewis, whoſe name and memory will ever be reſpected by all votaries to Chemiſtry, obſerving the inconveniencies that attended the uſe of both the foregoing kinds of furnaces, and taking the hint, as he candidly acknowledges, from an ingenious workman, and alſo reflecting on the durability of Black Lead Crucibles, and the eaſe with which the openings for doors, chimneys, &c. are made in them, contrived thoſe portable furnaces, ſo accurately and ſo properly deſcribed by him, in the firſt part of his excel-

excellent work, entitled *The Philoſophical Commerce of Arts*:—a work which if he had met with due encouragement to proſecute, and had completed according to his ideas on the ſubject, would have done infinite honour to himſelf and to his country. Since that time, it does not appear that any one has made an eſſential alteration in the conſtruction of theſe kinds of inſtruments, except the ingenious Meſſrs. Ruhl and Hempel, of Cheyne Row, Chelſea, who having, under the patronage of the Society, eſtabliſhed a manufactory of Black-Lead Pots, and profiting by the thoughts of Dr. Lewis, have employed themſelves in making furnaces, in a very neat and commodious manner, of the ſame materials their pots are formed of; and the only objection to them, is the price at which they muſt neceſſarily be ſold on account of the value of the materials, and the workmanſhip; in every other reſpect, they anſwer well the purpoſes they

are intended for, being ingeniouſly contrived, and executed in a workman-like manner.

It would be highly improper here to omit obſerving that the juſtly-admired Boerhaave mentions two kinds of portable furnaces contrived by himſelf, the one formed of wood, lined with iron plate, in which only thoſe operations that require a very gentle heat, hardly exceeding that of boiling water, could be performed. As, in this furnace, a ſmall equable fire may conveniently be kept up without much trouble or expence, he calls it *Furnus ſtudioſorum*. His other furnace he directs, like thoſe of Becher, to be made of plate iron, but lined with brick ſet in mortar made of lime and ſand: this furnace, however, as deſcribed by him, ſeems too large for experiments; and in ſtrong heats, every one knows how improper it is to have lime come in contact with the bricks,

bricks, which are liable to be greatly injured by it: and indeed neither of theſe furnaces have theſe many years paſt been much uſed.

The celebrated Pott, in his treatiſe, entitled *Lithogeognoſia*, alſo deſcribes a portable furnace, of which a deſign is annexed to his work: in this furnace, he ſays, every thing in nature, that is fuſible, may be melted in an hour or two. He acknowledges this furnace to be very ſimilar to that of Becher, and deſcribes the lute he lined it with, as compoſed of equal parts of pipe clay, burnt and unburnt, mixed together and moiſtened to the conſiſtence of paſte, with bullocks blood. It is evident this will be ſubject to all the inconveniencies of the other furnaces lined with lute.

The principal objection that has ariſen againſt the furnaces of Becher and Shaw, is that the lute, being a mixture of ſand, clay, and water, muſt neceſſarily ſhrink, and conſequently crack in drying: but this evil may in ſome degree be remedied by filling up the cracks, when dry, but before a fire is lighted, with freſh lute, which will, if artfully managed, adhere pretty well to the firſt layer: but there ſtill remains an inſuperable obſtacle, which is, the iron rivets that paſs through the ſides of the furnace, into the lute, expanding in great heats, and contracting with cold, in a degree very different from that of the mixture of clay and ſand that ſurrounds them, they are continually cracking the lute, and ſerve rather to ſeparate and throw it off from the iron plate, than to retain and fix it.

The chief objection to the Black Lead Furnaces of Dr. Lewis, is the thinneſs of

of the crucibles of which they are formed; this not only permits a large proportion of heat to eſcape, but, when the furnace grows red hot, tends very much to incommode the operator, and heat the room wherein any experiments are making.

It is with a view to remedy theſe inconveniencies, rather than to propoſe any new form of a furnace, that this paper is ſubmitted to the conſideration of the Society; and this end is obtained by uniting, in ſome degree, the three above-mentioned contrivances, by adopting the iron of the furnace of Becher, the bricks of Vigani, and the ſize of Dr. Lewis, which ſeems beſt adapted to experimental enquiries.

To form the body of the furnace, which is the only part intended to be here deſcribed (as any perſon converſant with

with theſe machines will readily faſhion the dome and other parts as may beſt ſuit their intention); procure a Cylinder, about eleven inches in diameter, and twelve or fourteen in length, made of ſtrong plate iron, rivetted together; or, as the thickneſs of the lining will prevent its ever becoming hot enough to melt hard ſolder, it will be much neater, if the joint be brazed. At one end, which is to be conſidered as the bottom of the cylinder, a piece muſt be cut out, about four inches ſquare, which is to be the opening to the aſh hole; to this an iron door is to be fitted; juſt above this opening, three iron pins, projecting half an inch or more withinſide the cylinder, muſt be well rivetted on, at equal diſtances from each other: four or five inches above theſe pins, let another hole be cut in the iron cylinder, and a door fitted to it; this ſerves for putting in the fuel, when the furnace is uſed for diſtilling,

and

and ſuch operations as require only a gentle heat.

On the pins before mentioned, lay an iron grate; and let the whole of the cylinder, above this grate, be lined with fire bricks, the joints well fitted, and laid in loam: by this means, the objection to the lute of Becher and Shaw, is obviated; and as the bricks may be left an inch and half or more in thickneſs, the heat will be better retained than in the black-lead furnaces of Dr. Lewis. To ſecure the iron door, whenever the furnace is to be uſed as a wind hole, or any ſtrong fire raiſed therein, a piece of fire brick is to be fitted to the opening, and the door ſhut, which will effectually preſerve the iron from injury.

It has been cuſtomary to make portable furnaces in the form of a truncated cone, the ſmaller end being the lower part

part, that different-fixed grates may fit at different heights: if this ſhape is ſtill thought eligible, it may be eaſily obtained, by leaving thoſe bricks that are next the grate, thicker than thoſe towards the upper part; and the diminution may either be regular, or projections left at the heights required, on which the different grates may reſt.

Fire bricks, fit for this purpoſe, are eaſily obtained in every part of this kingdom; and in London, they are conſtantly to be met with, at a low price, being ſent hither of two kinds, under the names of Windſor Bricks, and Nonſuch Bricks; the firſt ſo called from being brought from the town of that name, and the other from their being made at Nonſuch Park, near Epſom, Surrey. Theſe bricks ſtand every degree of fire well, and are of ſo ſoft a texture, as readily to admit of cutting and grinding into any form required, ſo as to be eaſily adapted

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to the figure of the furnace. And as the loam or earth of which they are made, is alſo brought to town for ſetting them, that alſo may be readily obtained; and thus ſmall portable furnaces, more durable, and better adapted to the making chemical experiments, than any I have hitherto met with, are eaſily and at little expence conſtructed.

The very reſpectable authors I have already quoted, have given ſuch preciſe and accurate deſcriptions of the forms beſt adapted to the uſes intended, that no additions need be made to their works on that head; and the well-known furnace of Dr. Black, of Edinburgh, when lined with brick, as now recommended, will be found greatly to exceed in utility thoſe which, having been hitherto lined with lute, have been liable to the objections ſtated above.